

**MISSOURI DEPARTMENT OF NATURAL RESOURCES  
AIR AND LAND PROTECTION DIVISION  
ENVIRONMENTAL SERVICES PROGRAM  
Standard Operating Procedures**

SOP #: MDNR-FSS-212 EFFECTIVE DATE: September 21, 2001

SOP TITLE: Operation of the Geoprobe Soil Probing System

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SUMMARY OF REVISIONS: Not Applicable, this is a new SOP

APPLICABILITY: Applies to the operation of the Geoprobe Soil probing system by  
FSS or EERS personnel of the Environmental Services Program

DISTRIBUTION: Supervisors, FSS and EERS, ESP  
SOP Coordinator  
MoDNR Intranet

RECERTIFICATION RECORD:

<b>Date Reviewed</b>				
<b>Initials</b>				

## 1.0 SCOPE AND APPLICABILITY

The purpose of this standard operating procedure (SOP) is to provide basic guidelines regarding the application and operation of the Geoprobe, either truck-mounted or track-mounted, hydraulic sampling device (Figure 1). Finding the source of petroleum and other contaminants that may leach into the ground can be very difficult due to a wide range of influencing factors that may include the natural geology of the site, man-made conduits, and the depth of the water table. The Geoprobe can help the field investigator more easily find the source of contamination and identify its areal extent, despite these influencing factors. These procedures apply to all ESP personnel who utilize the Geoprobe soil probing system.



Truck-Mounted Geoprobe



Track-Mounted Geoprobe

**Figure 1.** Truck and Track Mounted Geoprobes

## 2.0 SUMMARY OF METHOD

The Geoprobe is very specialized equipment that uses a hydraulically operated push drive system to collect intrusive data and samples for the primary purpose of locating subsurface contamination. Data can be collected with the Geoprobe in many ways. Field soil gas measurements can be collected by drawing soil gases from the borehole directly into a photoionization detector (PID), field gas chromatograph (GC) or Membrane Interface Probe (MIP). Depth discrete soil core samples and water samples can be removed from borings for later field or laboratory analyses. The Geoprobe can also be used to install monitoring wells, take soil conductivity readings, and trace the movement of volatile organic compounds through soil lenses using the MIP.

The Geoprobe is capable of penetrating through soils or other unconsolidated material to depths of up to 100 feet below the ground surface in a relatively short period of time.

### 3.0 DEFINITIONS AND ACRONYMS

- APR - Air Purifying Respirator
- Bucket Auger - A hand operated auger for collecting depth discrete soil samples
- Buddy System - A safety system where each person works directly with another, or a "buddy", in a two-person team
- CAS - Chemical Analysis Section
- EnCore - Sampling device used to collect soil samples for volatile organics analysis
- FID - Flame Ionization Detector
- Geoprobe - A hydraulic push probe device for collecting depth discrete soil samples
- HASP - Health and Safety Plan
- HAZWOPER - Hazardous Waste Operations and Emergency Response
- HSERP - Hazardous Substance Emergency Response Plan
- Macro-Core - A stainless steel tubing designed to accept liners for collecting continuous core samples
- MIP - Membrane Interface Probe. A probe attachment to the Geoprobe that allows volatile organic compounds to be detected through a heated membrane where they can be returned to PID and FID instruments for depth discrete, in-situ detection
- PETG - Polyethylene terephthalate with glycol
- PID (Photoionization Detector) - A portable air monitoring instrument used to measure the amount of ionizable organic vapors present
- PVC - Polyvinyl chloride
- Safety Officer - The person, generally the ESP sampler, who is assigned or assumes the duties of the health and safety officer for a specific investigation
- VOA - Volatile organics analysis

### 4.0 HEALTH AND SAFETY REQUIREMENTS

The Geoprobe is a very powerful machine that incorporates the use of hydraulics. Although it is designed with safety in mind, it can potentially be very dangerous to the operator if proper precautions are not taken. The health and safety warnings described below are not listed in any particular order and should all be considered when working with the Geoprobe.

- 4.1 The Geoprobe shall be operated using the "Buddy System" where no less than two individuals, a primary operator and an assistant, are present at all times. All individuals working in the vicinity of the Geoprobe must stay alert and in continual communication with the operator. Each person in a team should always maintain visual contact with his/her partner, with an emphasis on always being aware of each other's whereabouts in the event an accident or problem should occur. Clear verbal announcements of each intended move by the operator should always be made to insure that the assistant(s) understands and has sufficient opportunity to move clear of moving equipment.
- 4.2 All individuals working near the Geoprobe shall wear eye protection, hearing protection, a hardhat, gloves, and steel-toed boots.

- 4.3 A list of "do's and don'ts" for safety can be found in Section 3 of the Geoprobe owner's manual.
- 4.4 Both the Geoprobe truck and the trailer for the track-mounted probe are equipped with a first aid kit.
- 4.5 Missouri One Call (1-800/Dig-rite), as well as all non-member utilities, shall be contacted prior to any subsurface probing. All local requirements concerning special worker signs, flashing lights, or orange pylons shall be observed.
- 4.6 All work shall be conducted in strict accordance with an approved HASP. Any alterations to the plan shall be explained and documented in the field notebook.
- 4.7 A fire extinguisher shall be within easy reach at all times.
- 4.8 For any sampling investigation that occurs at a hazardous waste site, site specific health and safety requirements shall be described in the HASP. A site safety meeting shall be held by the ESP project manager or safety officer and shall take place in the field prior to conducting any fieldwork. All personnel directly involved in the fieldwork shall read and sign the HASP. While conducting field activities, the Safety Officer shall place a copy of the HASP in a location readily available to all field personnel.

## 5.0 PERSONNEL QUALIFICATIONS

All personnel involved in the collection of soil samples where hazardous substances may be encountered, must:

- attend the 40-hour HAZWOPER training as required by EPA's 40 CFR Part 311, referencing OSHA 29 CFR Part 1910;
- attend an annual 8-hour health and safety refresher course, or receive equivalent training;
- participate in the DEQ medical monitoring program;
- receive appropriate on-the-job training;
- be familiar with the HSERP, written and maintained by the ESP;
- be familiar with the ESP SOP manual and have read all SOP documents that are applicable to the field activities, including but not limited to those referenced in this SOP;
- attend EPA's "Sampling for Hazardous Materials" training (or equivalent).

An individual will not be permitted to serve as the primary operator of the Geoprobe until he/she has met the following requirements:

- Each primary operator shall first complete a minimum of eight hours of closely supervised hands-on Geoprobe operations training and satisfactorily demonstrate the ability to safely operate the machine. The training may be obtained either from Geoprobe Systems, Inc. personnel or from an experienced ESP operator. If the training is obtained in-house, it should initially be conducted using the, somewhat easier to operate, truck-mounted unit.

- Operators must possess a Missouri Well Drillers and Pump Installers Permit from the MDNR Division of Geology and Land Survey (DGLS) for soil depths beyond ten feet.

## 6.0 SUPPLIES AND EQUIPMENT

### 6.1 Soil sampling equipment

- 1.25" x 3' and/or 1.25" x 4' drive rods (Figure 2)



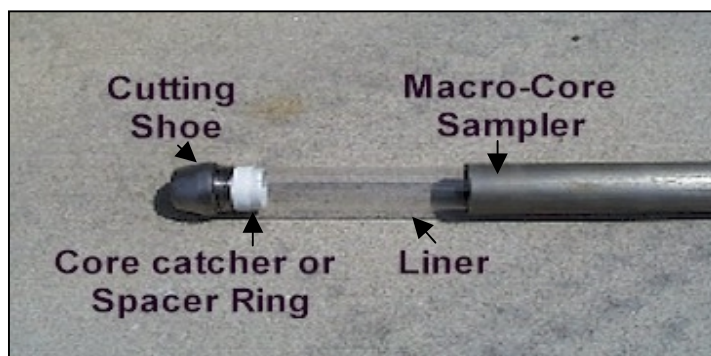
**Figure 2**

- drive and pull caps (Figure 3)



**Figure 3**

- 4' Macro-Core sampler (Figure 4)



**Figure 4**

- 2' large bore sampler with liners for discrete-interval sampling

### 6.2 Monitoring well installation equipment

- 2.125" x 3.0' outer casing drive rods
- 3.5" steel expendable anchor points
- 3' pre-packed PVC well screen assembly

- ½" x 5' schedule 80 PVC well riser
- ⅜" diameter water level indicator
- GS1000 gas powered grout pump
- above ground or flush-mount well covers

### 6.3 Water sampling equipment

- screen point 15 stainless steel retractable screen sampler (Figure 5)



**Figure 5**

- Geoprobe vacuum pump/fluid trap system
- bailers
- hand operated reciprocating pump

### 6.4 Soil conductivity equipment

- Wenner conductivity probe
- stringpot depth logger
- Geoprobe conductivity data acquisition system
- laptop computer

### 6.5 Permeable membrane sensor equipment, MIP

- membrane/conductivity probe
- stringpot depth logger
- MIP trunk line
- MIP control module w/FID/PID detectors

Additional accessory hand tools are also required for the operation of the Geoprobe, including pipe wrenches, screwdrivers, hammers, pliers, etc.

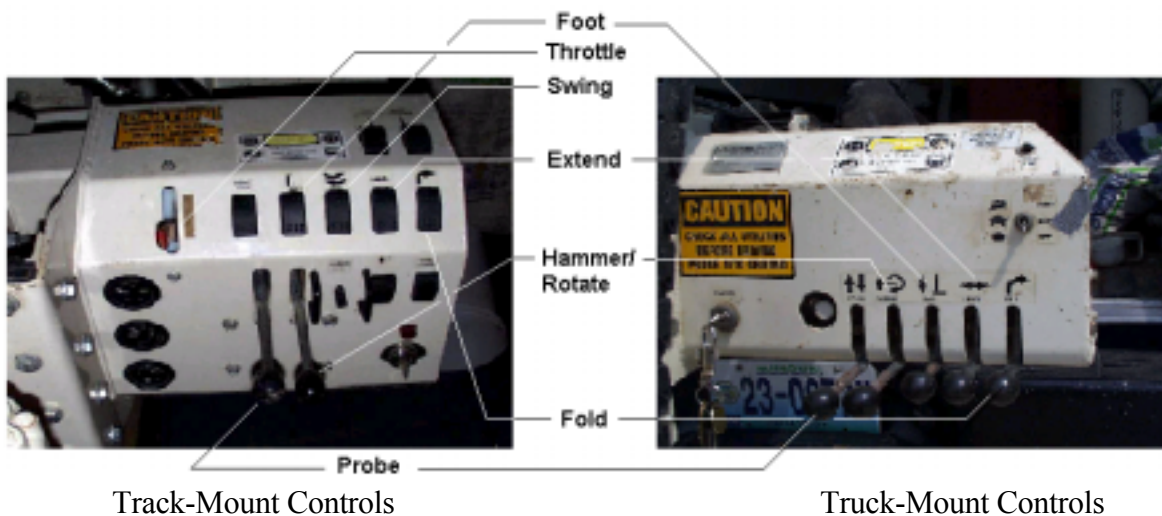
## 7.0 PROCEDURES

The Geoprobe uses a lever-controlled hydraulically-operated push and hammer system to drive a probe using three-foot (Model 4200, the truck-mount) or four-foot (Model 5400, the track-mount) drive rods to the desired depth or to refusal, whichever comes first. Various probe tips and attachments allow for the collection of subsurface data, either directly by the use of sensing equipment, or indirectly by the physical removal of subsurface media for later analyses. The track-mount probe is a slightly heavier unit that may be used in more rugged or hard to reach areas, or when a heavier unit may be required.

The basic operating procedures for the initial set-up of the Geoprobe are detailed below. The operator, however, shall be thoroughly familiar with the owner's manual.

## 7.1 Set-up operations

- 7.1.1 Set the parking break and/or chock at least one wheel on each side of the vehicle (truck-mounted).
- 7.1.2 Open and secure the rear topper doors (truck-mounted)
- 7.1.3 Position the switch (truck-mounted) to engage the hydraulic system:

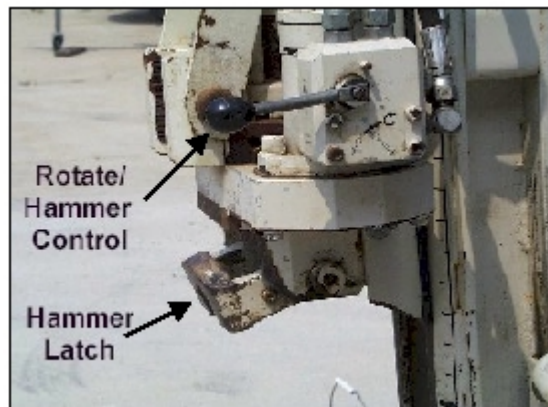


**Figure 6**

- FOLD is used to upright or lower the derrick unit.
  - EXTEND is used to move the derrick unit in towards or out away from the unit.
  - SWING (track-mounted) moves the derrick left and right of center.
  - FOOT moves the derrick assembly up or down.
  - HAMMER is activated only when assembly is moving downward.
  - PROBE is used to drive probe rods to depth using the static weight of the vehicle. If this does not drive the unit, use the HAMMER (insure that the Rotate/Hammer Control is in the Hammer position, Figure 7) simultaneously to assist in further advancing the rods to the desired depth.
- 7.1.4 Using the EXTEND lever, move the derrick out away from the vehicle.
  - 7.1.5 With the FOLD lever, raise the derrick to the upright or vertical position. When using the truck-mount, insure that the derrick is extended far enough to clear the roof of the topper when raised.
  - 7.1.6 Lower the probe foot with the FOOT lever until it reaches the ground. Continue lowering the foot until it is partially supporting the weight of the vehicle.



- 7.1.7 Raise the probe using the PROBE lever to its maximum height to allow for rod and probe attachments.



**Figure 7**

## 7.2 Field Investigations

### 7.2.1 Core Sampling

- Soil core samples can be collected using the Macro-Core Soil Sampler (see Geoprobe Standard Operating Procedures: Technical Bulletin No. 95-8500 *Geoprobe Macro-Core Soil Sampler*). The core sampler allows for the collection and observation of depth discrete or continuous samples. An entire profile of the total depth of a core can be obtained. With the use of clear liners constructed of PVC or PETG, the operator may easily view soil lenses and other anomalies that may affect the movement of contaminants through the soil. The sample is contained in the liner, which eliminates much of the decontamination procedures needed for other methods. The use of “core catchers” helps maintain samples when loose soils are being sampled. Either a core catcher or a spacer ring should always be used in conjunction with a liner to minimize the risk of the liner becoming jammed in the Macro-Core Soil Sampler.
- Soil sampling procedures can be found in MDNR-FSS-010 *Collection of Soil Samples* and MDNR-FSS-006B *Sampling Soils and Other Media for Volatile Organic Analysis (VOA)*.

### 7.2.2 Groundwater Sampling

Groundwater samples can be collected using the Geoprobe Screen Point 15 Groundwater Sampler or by installing pre-pack screened monitoring wells (see Geoprobe Standard Operating Procedures: Technical Bulletin No. 95-1500 *Geoprobe Screen Point 15 Groundwater Sample*, and Technical Bulletin No. 96-2000 *Geoprobe Pre-packed Screen Monitoring Well*). These procedures allow the operator to collect groundwater samples from temporary or permanent monitoring wells. Procedures for water sampling from wells can be found in MDNR-FSS-007 *Collection of Samples from Wells*.



### 7.2.3 Volatile Organics Detection

In-situ volatile organics readings can be obtained using the MIP. The MIP is a highly technical instrument that uses a membrane, through which a volatile organic compound can diffuse. The volatile compound is then passed, via a carrier gas, past both a photo and a flame ionization detector that records a quantitative level. The MIP is also capable of recording the depth of the probe and conductivity of the surrounding soils (see MIP owner's manual). Sampling for volatile organics analysis can be found in MDNR-FSS-006A *Sampling Water and Other Liquids for Volatile Organic Analysis (VOA)* and MDNR-FSS-006B *Sampling Soils and Other Media for Volatile Organic Analysis (VOA)*.

### 7.2.4 Sample Collection Procedures

The following procedures may apply to sampling investigations using the Geoprobe:

- MDNR-FSS-001 *Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Considerations*
- MDNR-FSS-002 *Field Sheet and Chain-of-Custody Record*
- MDNR-FSS-003 *Sample Numbering and Labeling*
- MDNR-FSS-004 *Field Documentation*
- MDNR-FSS-006A *Sampling Water and Other Liquids for Volatile Organic Analysis (VOA)*
- MDNR-FSS-006B *Sampling Soils and Other Media for Volatile Organic Analysis (VOA)*
- MDNR-FSS-018 *Sample Handling: Field Handling, Transportation, & Delivery to the ESP Lab*
- MDNR-FSS-100 *Field Analysis of Water Samples for pH*
- MDNR-FSS-101 *Field Measurement of Water Temperature*
- MDNR-FSS-102 *Field Analysis of Specific Conductance*
- MDNR-FSS-106 *Field Analysis of Flash Point*
- MDNR-FSS-204 *Field Operation of Explosimeter and Measurement of Explosivity*
- MDNR-FSS-206 *Decontamination Procedures for Sampling Equipment*

## 7.3 Sampling Considerations

- 7.3.1 When collecting samples for VOA, the direction of wind should be considered to help eliminate the potential influence of vehicle exhaust or other fumes.
- 7.3.2 To prevent contamination of down-hole samples, lubricants or rust inhibitors should not be used on fittings, rods, or Macro-Core Soil Samplers.
- 7.3.3 All down-hole equipment will be properly decontaminated prior to reuse in the field. See MDNR-FSS-206 *Decontamination Procedures for Sampling Equipment*.

## 7.4 Shut-down Operations

- 7.4.1 To remove the probe rod and attachment from the hole, attach the pull cap to the top of the rod. Bring the derrick down to the top of the pull cap and position the hammer latch (Figure 7) onto the pull cap. Pull up on the probe lever to extract the rod, unscrewing each of the 3- or 4-foot rod lengths until all are removed. Note: Sometimes it is necessary to use a pipe wrench or other device to secure a drive rod to prevent it from sliding back down into a borehole. Extreme caution must be exercised to prevent the drive rod and pipe wrench from slipping and smashing a finger or hand.
- 7.4.2 Raise the foot slightly using the FOOT lever.
- 7.4.3 Completely lower the hammer using the PROBE lever.
- 7.4.4 Using the FOLD lever, fold the derrick onto the derrick stop.
- 7.4.5 Retract the derrick back toward the vehicle using the EXTEND lever.
- 7.4.6 Raise the foot to the “UP” position using the FOOT lever and, for the truck-mount, switch off the hydraulics.
- 7.4.7 Abandonment and registration of boreholes and the installation of monitoring wells will be conducted in accordance with MDNR-DGLS regulations (10 CSR 23 and/or sections 256.600-.640 RSMo).
- 7.4.8 Make entry into the drill log, if applicable.
- 7.4.9 Always leave property in the same or better condition as you entered it.
- 7.4.10 Always clean all equipment and replace supplies upon returning from the field, as if the next trip were yours.
- 7.4.11 Insure that all preventative maintenance tasks are conducted prior to storage. See appropriate owner’s manual.

## 8.0 REFERENCES

- Geoprobe Standard Operating Procedures: Technical Bulletin No. 95-8500 *Geoprobe Macro-Core Soil Sampler*
- Geoprobe Standard Operating Procedures: Technical Bulletin No. 96-2000 *Geoprobe Pre-packed Screen Monitoring Well*
- Geoprobe Standard Operating Procedures: Technical Bulletin No. 95-1500 *Geoprobe Screen Point 15 Groundwater Sampler*
- MDNR Field Services Section standard operating procedures
- Owner’s manual (each Geoprobe and MIP), Geoprobe Systems, Inc.